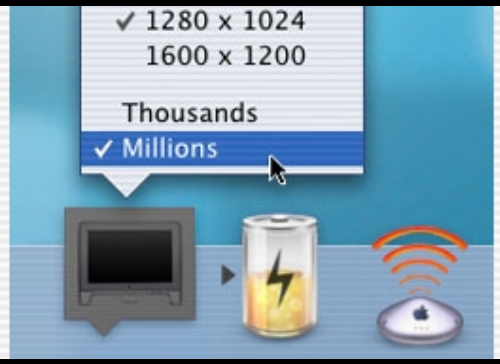
Session 102

Cocoa Overview



Chuck Pisula
Cocoa Frameworks

Introduction

- Cocoa is an advanced object oriented framework
- Provides a full feature set
- Integrates with other system components
- Used by many important Mac OS X applications

What You'll Learn

- High-level introduction to Cocoa
  - What makes Cocoa unique
  - What are the important classes
  - What are the main concepts and features
- Cocoa is powerful, easy to use, and makes you more productive

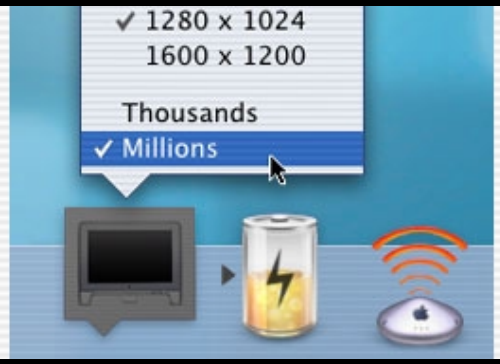
Powerful and Easy

- Powerful
  - Object-oriented framework
  - Designed for extensibility
  - Dynamic runtime system
- Easy to use
  - Consistent APIs and conventions
  - Available in Objective-C and Java

Maximum Productivity

- NO LINES for a reasonable text editor
- Cocoa gives you a lot for FREE!!
- You get to spend more time on features that make your product unique

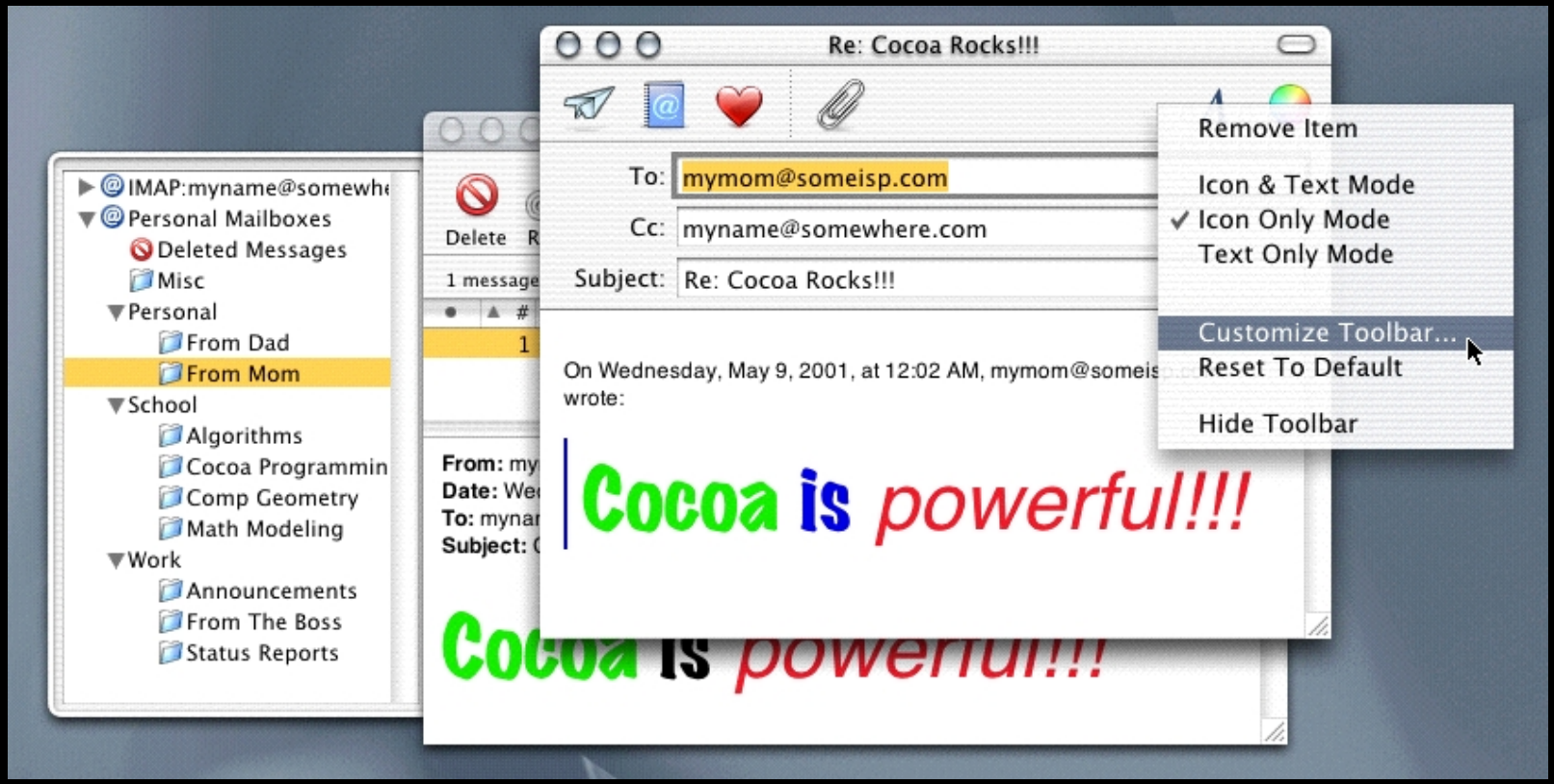
Demo



Douglas Davidson
Cocoa Frameworks

Cocoa Gives You a Lot for FREE!!

Mail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From Dad
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Math Modeling
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Announcements
From The Boss
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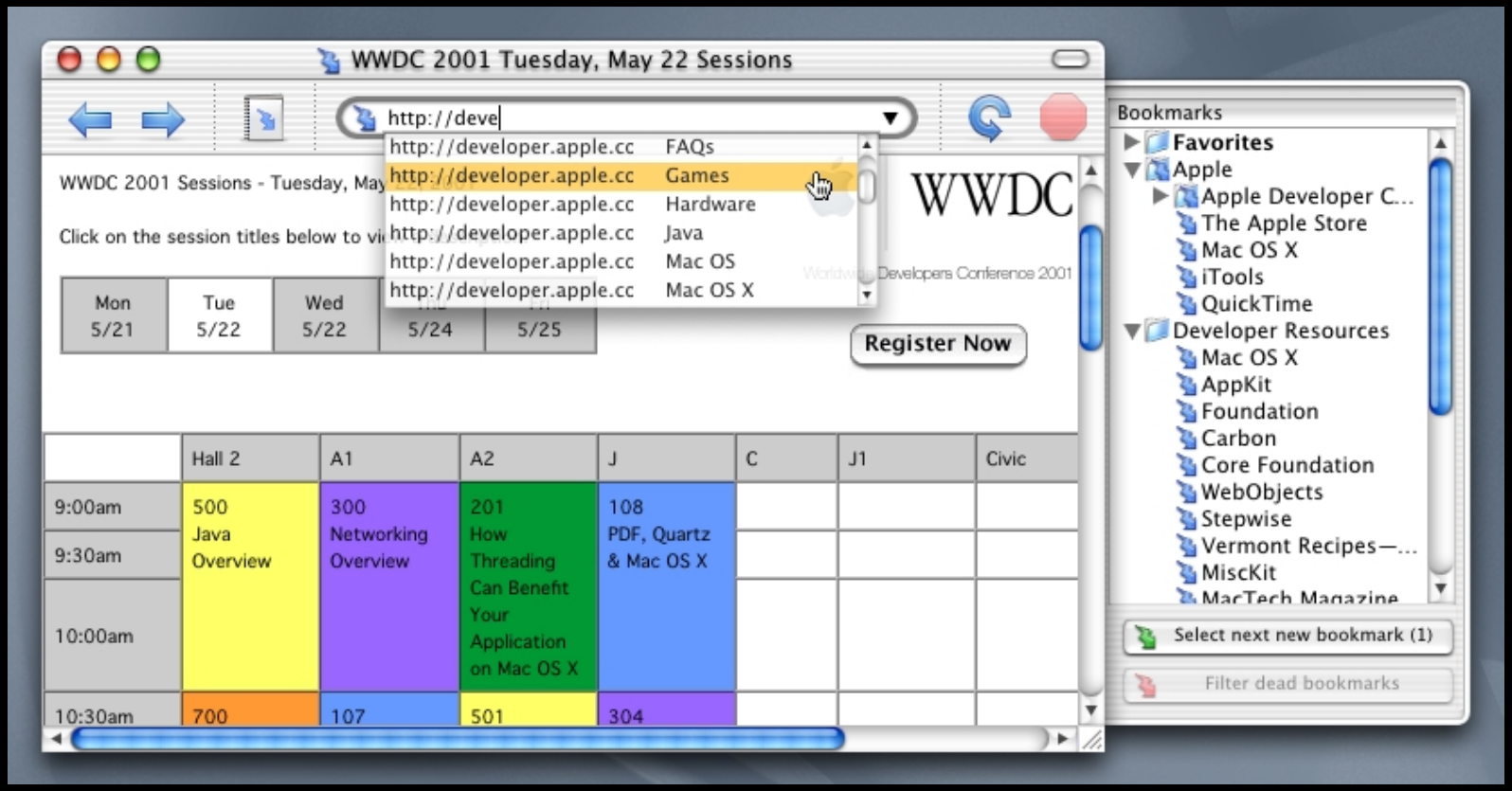
Delete
1 message
To: mymom@someisp.com
Cc: myname@somewhere.com
Subject: Re: Cocoa Rocks!!!
On Wednesday, May 9, 2001, at 12:02 AM, mymom@someis
wrote:
Cocoa is powerful!!!
Remove Item
Icon & Text Mode
Icon Only Mode
Text Only Mode
Customize Toolbar...
Reset To Default
Hide Toolbar

Maximum Productivity

- 75,000 lines for a full featured mail application
  - Mail handles IMAP, POP, inline attachments, address book integration, etc…
  - 15K comments
  - 40K reusable frameworks
  - 20K code specific to Mail

OmniWeb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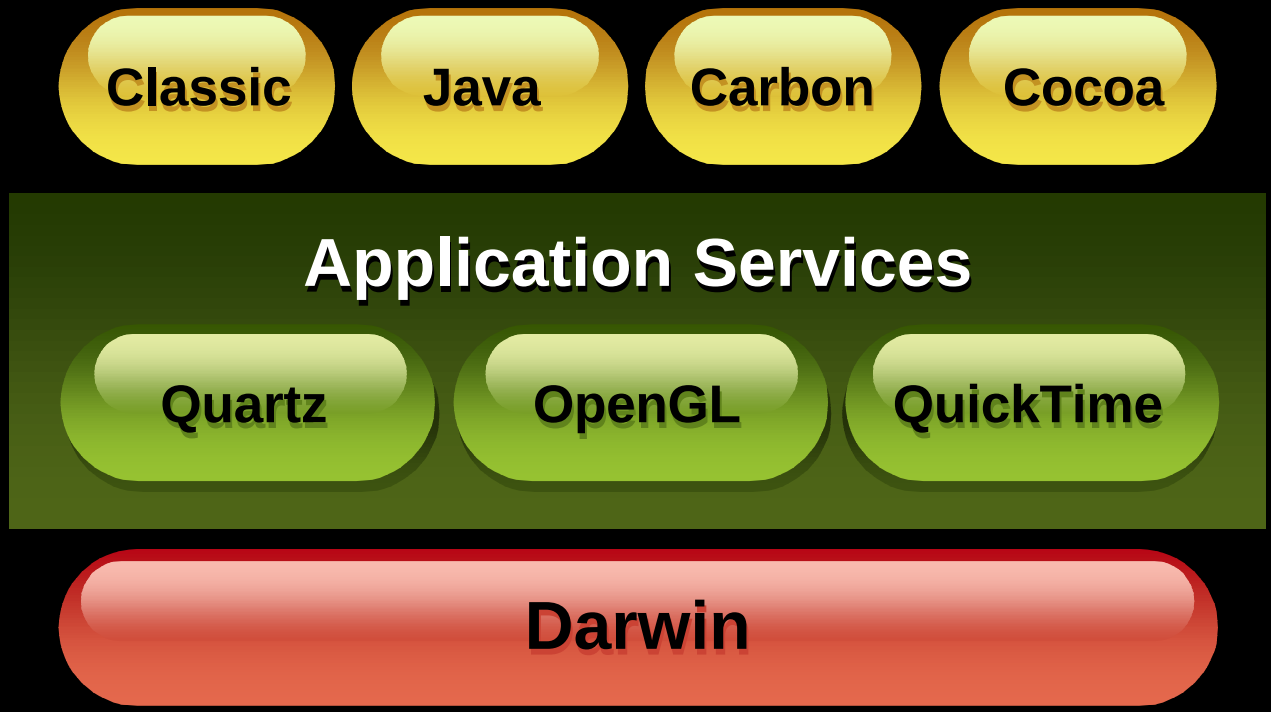
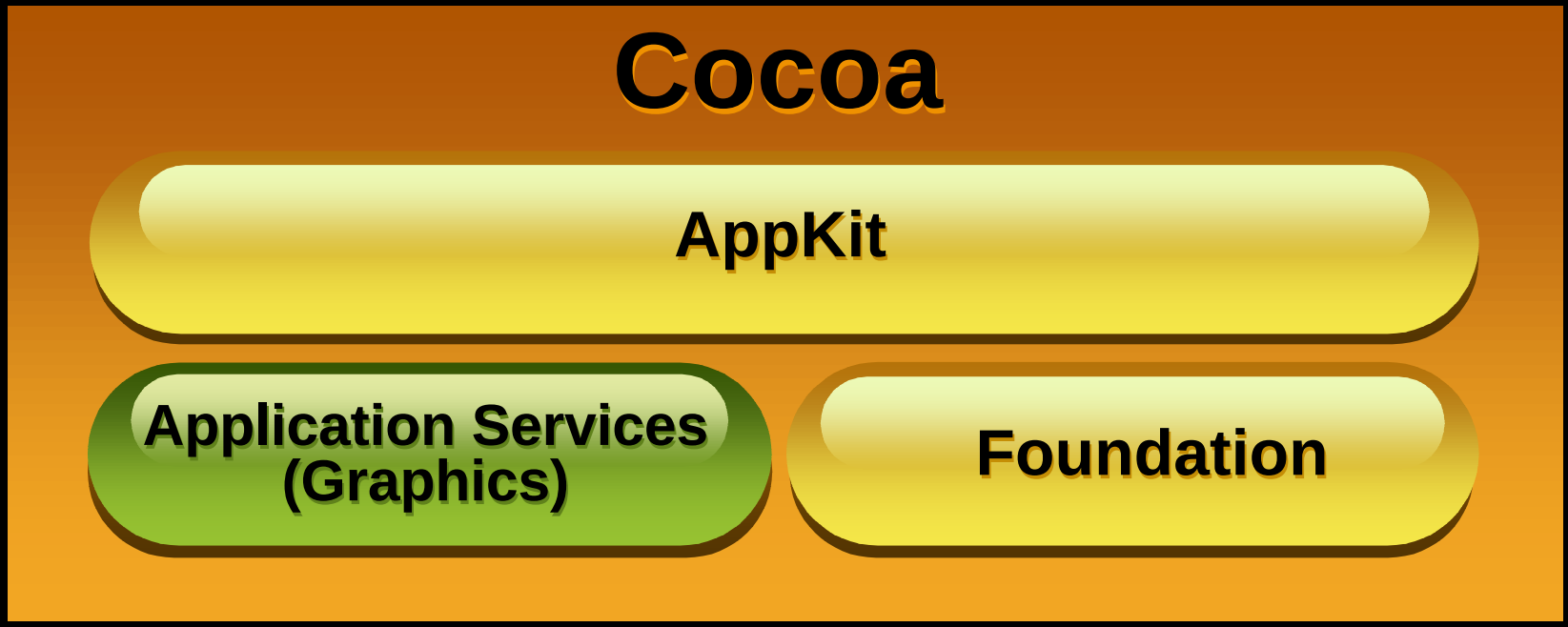
Maximum Productivity

- 300,000 lines for a full featured web browser
  - 120K imported C code to support various bundles
  - 140K packaged in 7 reusable frameworks for networking, web, HTML, controls, etc…
  - 36K code specific to OmniWeb

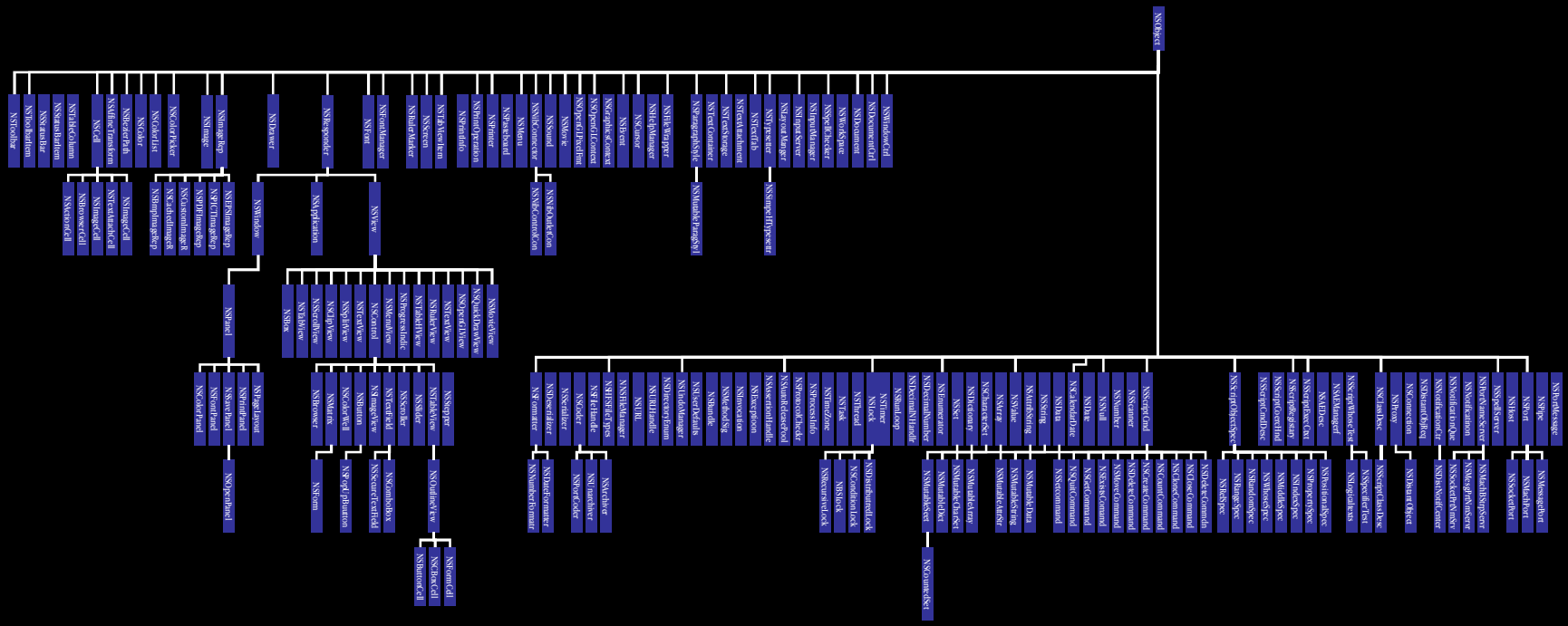
Where Does Cocoa Fit?



A Closer Look



Full Featured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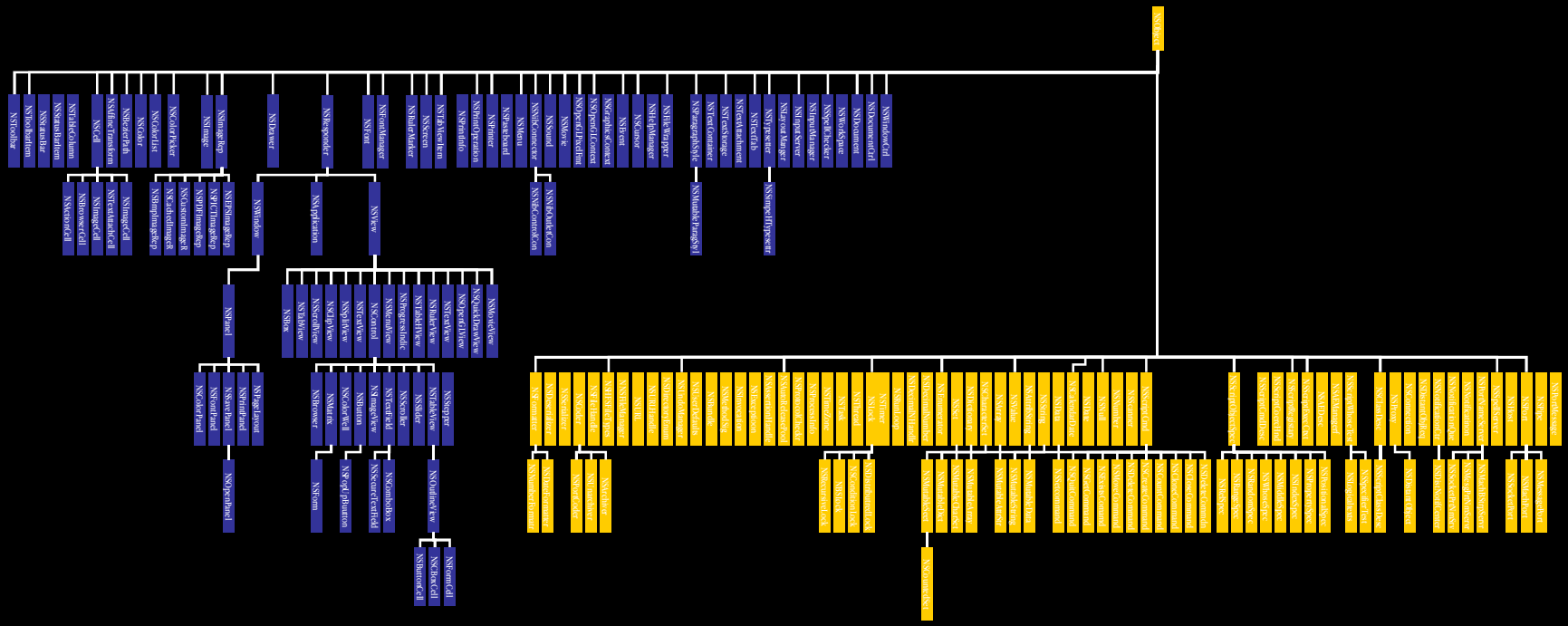
Foundation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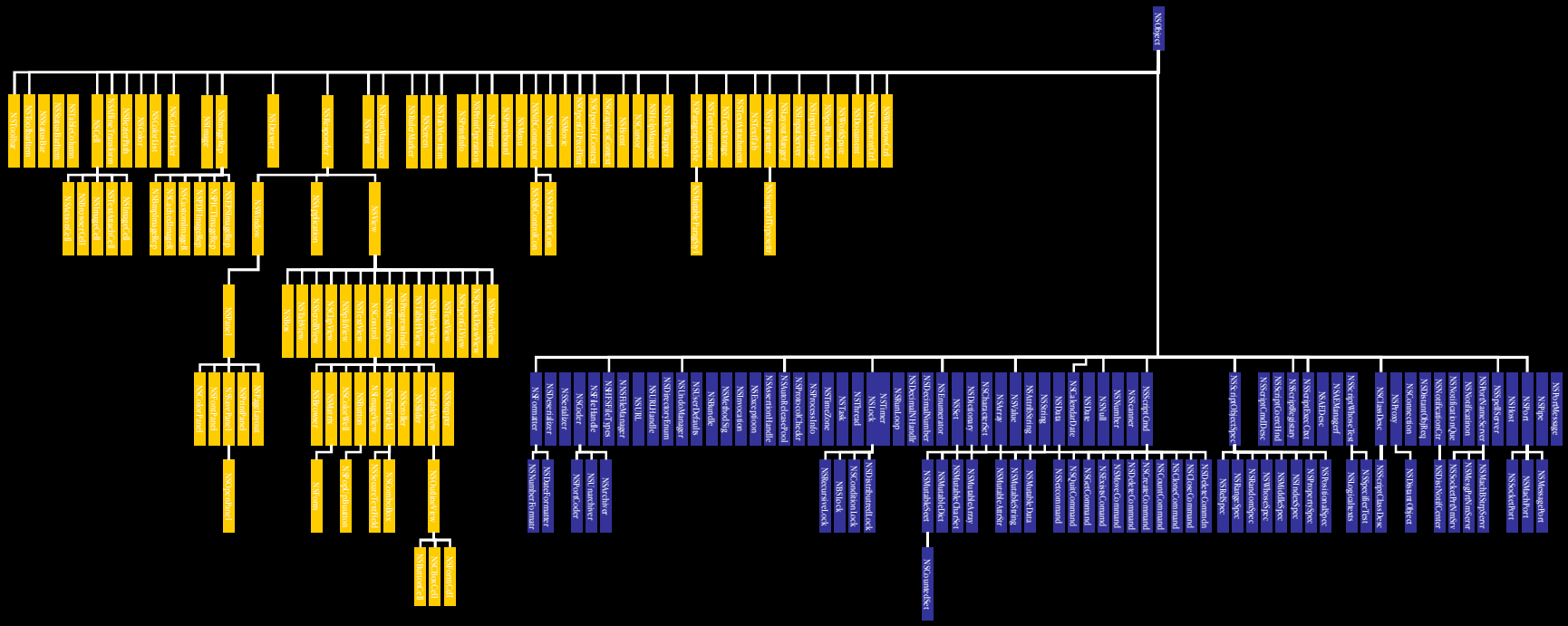
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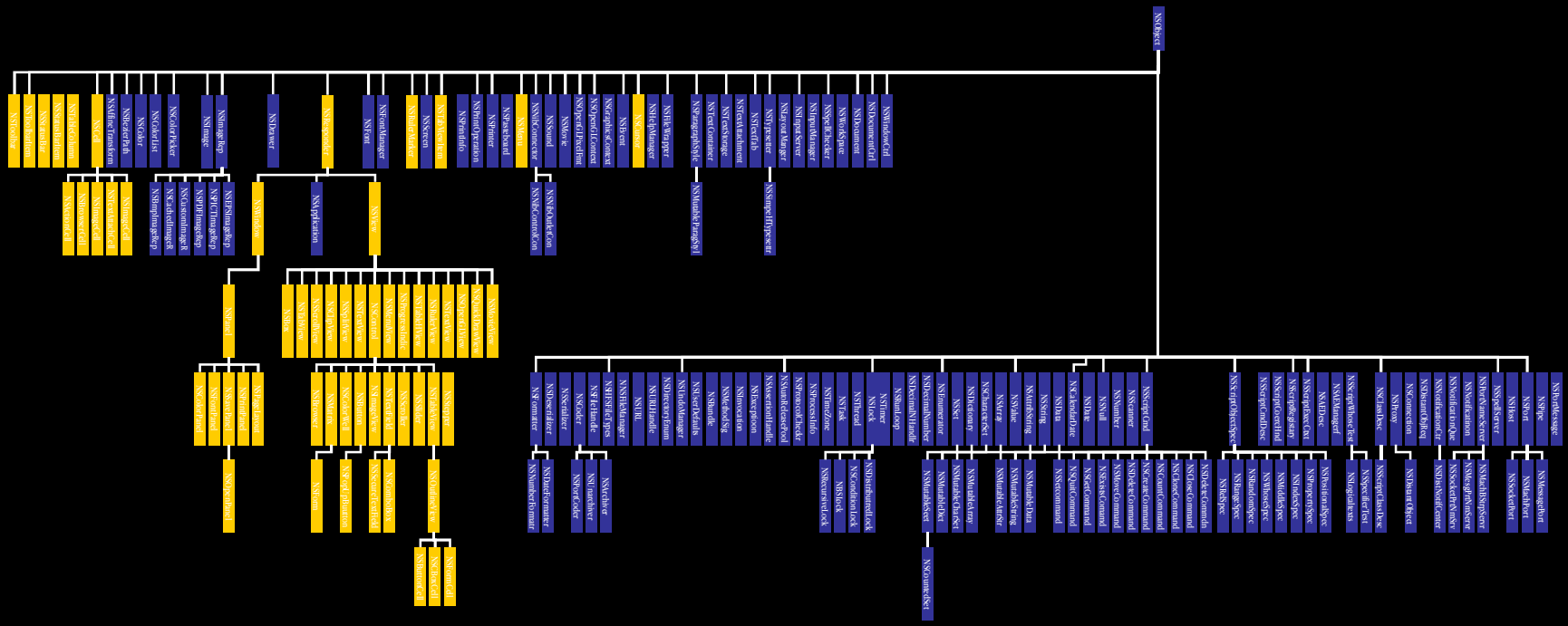
Windows & Views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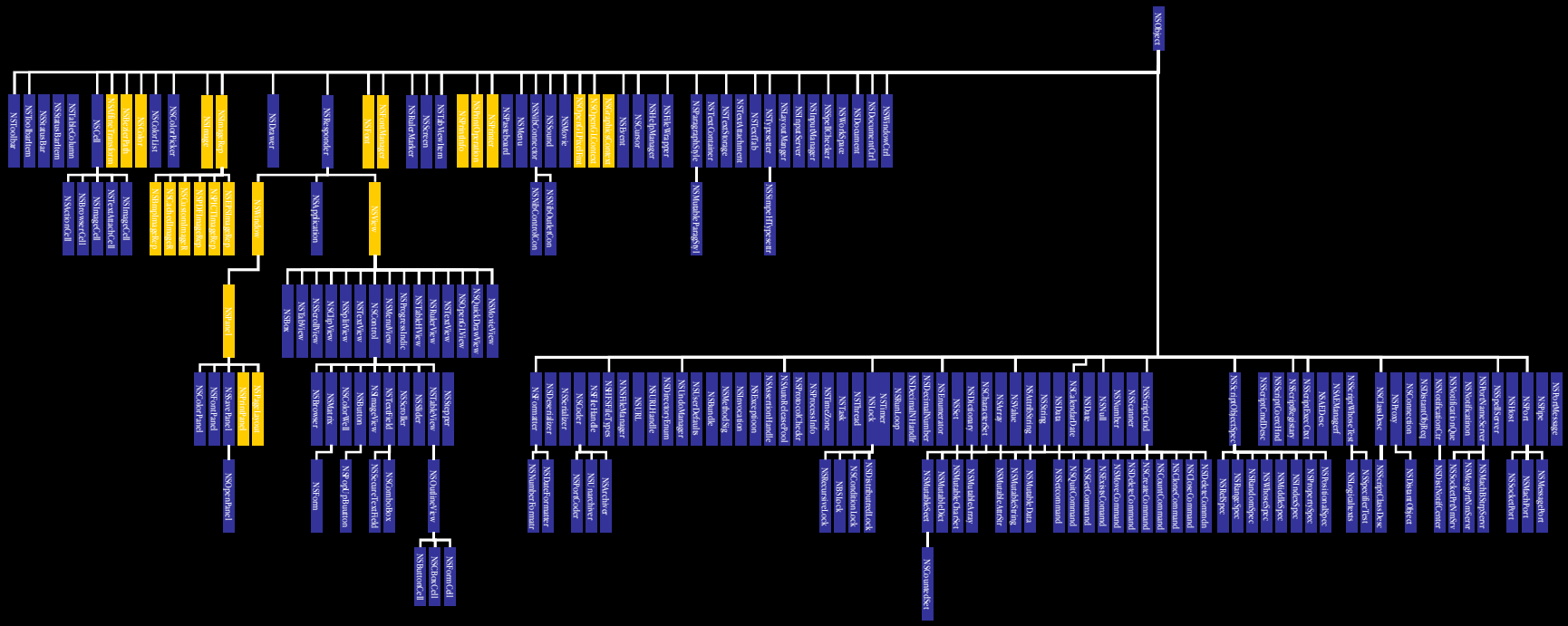
Graphics & Imaging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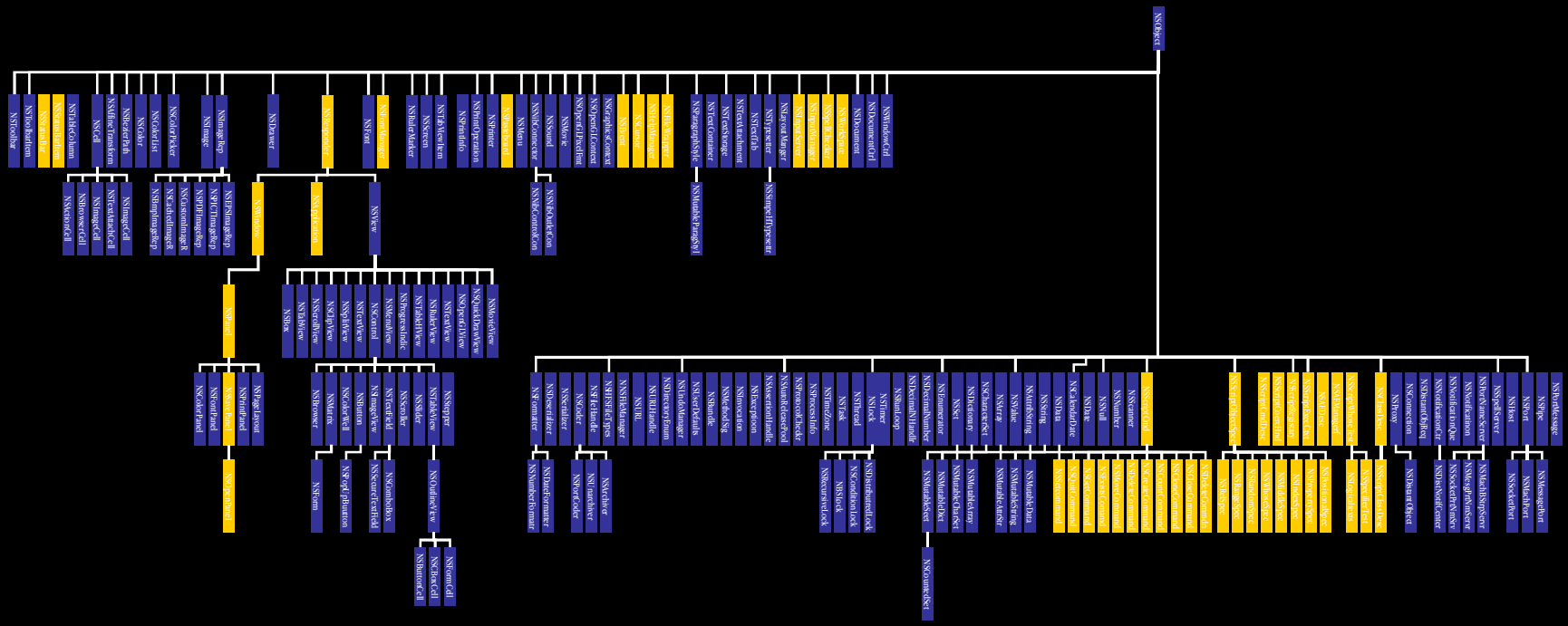
Events & System Interaction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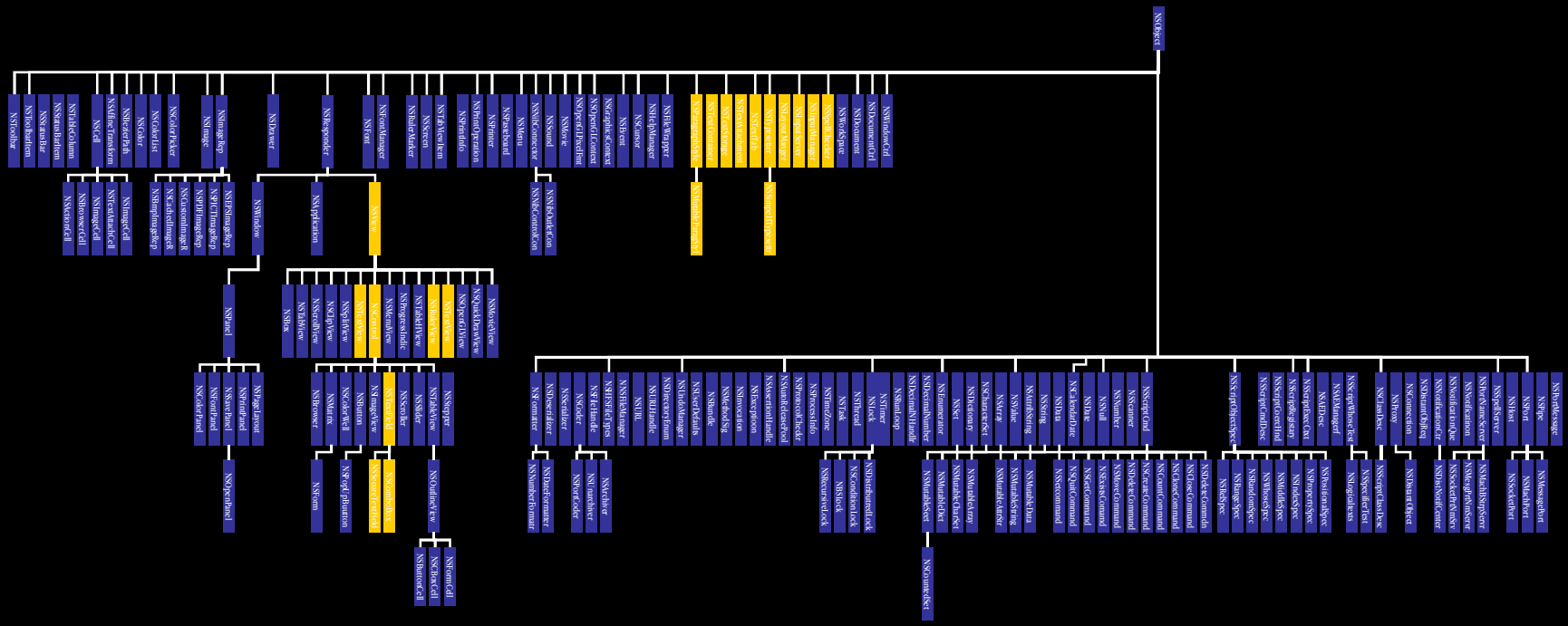
Text Handling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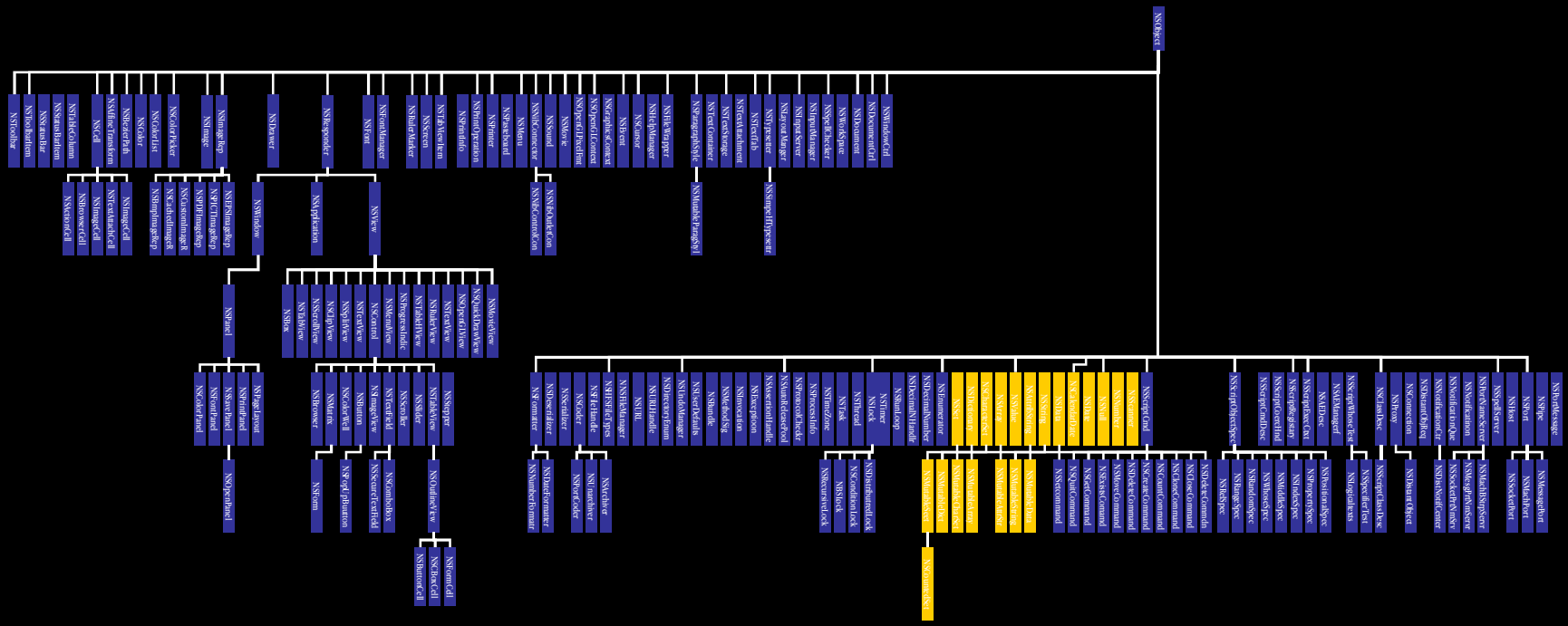
Storage & Collections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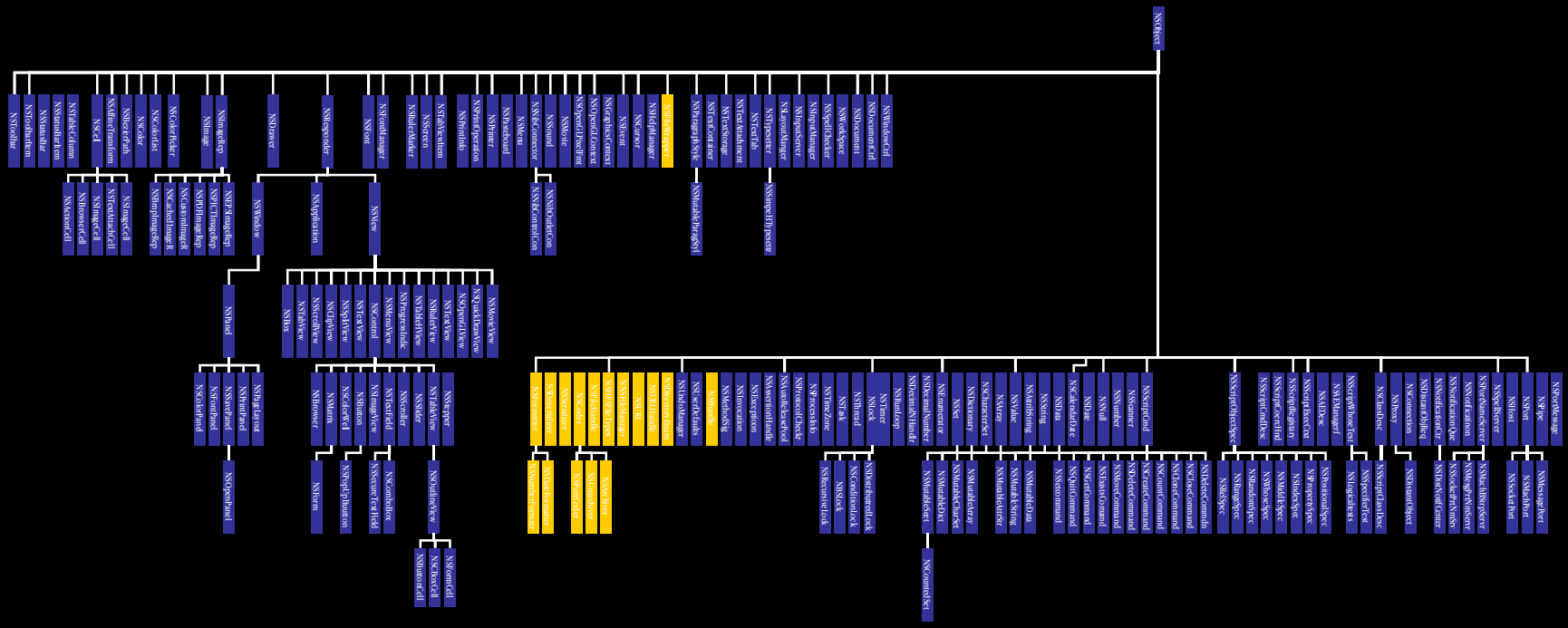
File I/O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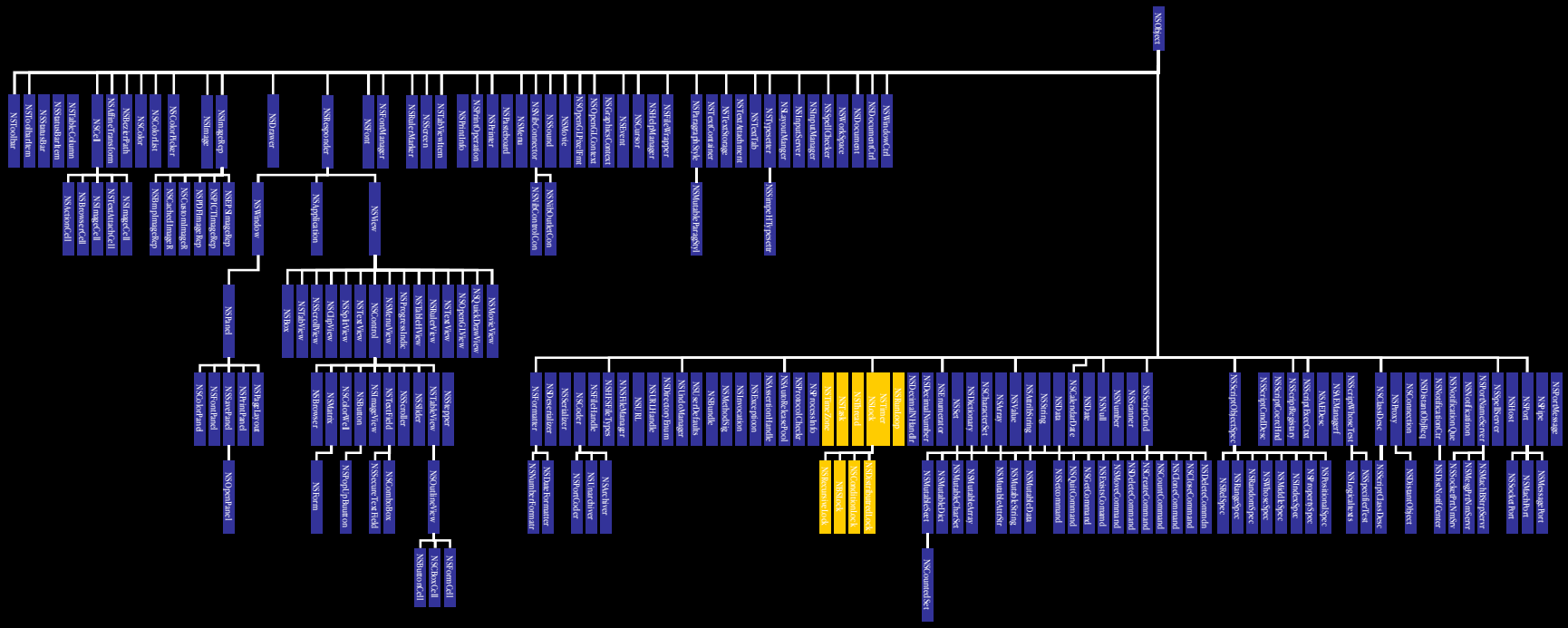
Processes & Threading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NSPageLayout
NSView
NSBox
NSClipView
NSScrollView
NSSplitView
NSTextView
NSControl
NSMatrix
NSBrowser
NSCell
NSButtonCell
NSImageCell
NSTextFieldCell
NSSecureTextField
NSComboBox
NSFormCell
NSTitleTextCell
NSSlider
NSTableView
NSOutlineView
NSBrowserCell
NSDocCell
NSFormCell
NSSplitPaneButton
NSTerm
NSScrollerPart
NSMenuView
NSProgressIndic
NSTabbedView
NSTabularView
NSTextView
NSSpecialView
NSQuickDrawView
NSMoveView
NSFont
NSFontManager
NSMutableFontFamily
NSScreen
NSTableSelection
NSPrintInfo
NSPrinter
NSPasteboard
NSMenu
NSNetConnector
NSNetConnectCon
NSNetOutletCon
NSSound
NSMovie
NSSpellDictionary
NSSpellDictionaryFmt
NSGraphicsContext
NSEvent
NSCursor
NSHelpManager
NSHelpPlaceMgr
NSGraphicsStyle
NSMutableParagraphSty
NSTextContainer
NSTextStorage
NSTextAttachment
NSTextTab
NSPresenter
NSSingleDTPresenter
NSLayoutManager
NSInputServer
NSSpellChecker
NSInputManager
NSWorkSpace
NSDocument
NSDocumentGrid
NSWindowGrid
NSNumber
NSNumberFormatter
NSDecimalNumber
NSDecimalNumberHandler
NSNumberValue
NSNumberZero
NSInteger
NSUInteger
NSNumberOne
NSNumberNegOne
NSNumberTwo
NSNumberNegTwo
NSNumberMaxInt
NSNumberMinInt
NSNumberMaxUInt
NSNumberMinUInt
NSNumberMaxLong
NSNumberMinLong
NSNumberMaxULong
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NSNumberMaxLLong
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NSNumberNaN
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NSNumberNegInf
NSNumberFormatter
NSSerializer
NSArchiver
NSCoder
NSUnarchiver
NSKeyedArchiver
NSKeyedUnarchiver
NSTypedStream
NSFileHandle
NSFileManager
NSURLHandle
NSURL
NSURLRequest
NSMutableURLRequest
NSURLResponse
NSHTTPURLResponse
NSURLCache
NSCachedURLResponse
NSURLConnection
NSURLDownloadBehavior
NSURLDownload
NSURLAuthenticationChallenge
NSURLProtectionSpace
NSURLCredentialStorage
NSURLCredential
NSURLProtocol
NSURLProtocolClient
NSURLRequestMutability
NSURLRequest
NSMutableURLRequest
NSURLSessionConfiguration
NSURLSession
NSURLSessionTask
NSURLSessionDataTask
NSURLSessionUploadTask
NSURLSessionDownloadTask
NSURLSessionStreamTask
NSURLSessionWebSocketTask
NSURLSessionWebSocketMessage
NSURLSessionDelegate
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NSURLSessionDataDelegate
NSURLSessionDownloadDelegate
NSURLSessionStreamDelegate
NSURLSessionWebSocketDelegate
NSURLSessionDelegateDefaults
NSURLSessionTaskDelegateDefaults
NSURLSessionDataDelegateDefaults
NSURLSessionDownloadDelegateDefaults
NSURLSessionWebSocketDelegateDefaults
NSURLSessionTaskMetrics
NSURLSessionTaskTransactionMetrics
NSURLSessionTaskDeferredLoadingPolicy
NSURLSessionTaskPriority
NSURLSessionTaskPriorityDefault
NSURLSessionTaskPriorityLow
NSURLSessionTaskPriorityHigh
NSURLSessionTaskPriorityRange
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NSURLSessionTaskPriorityMax
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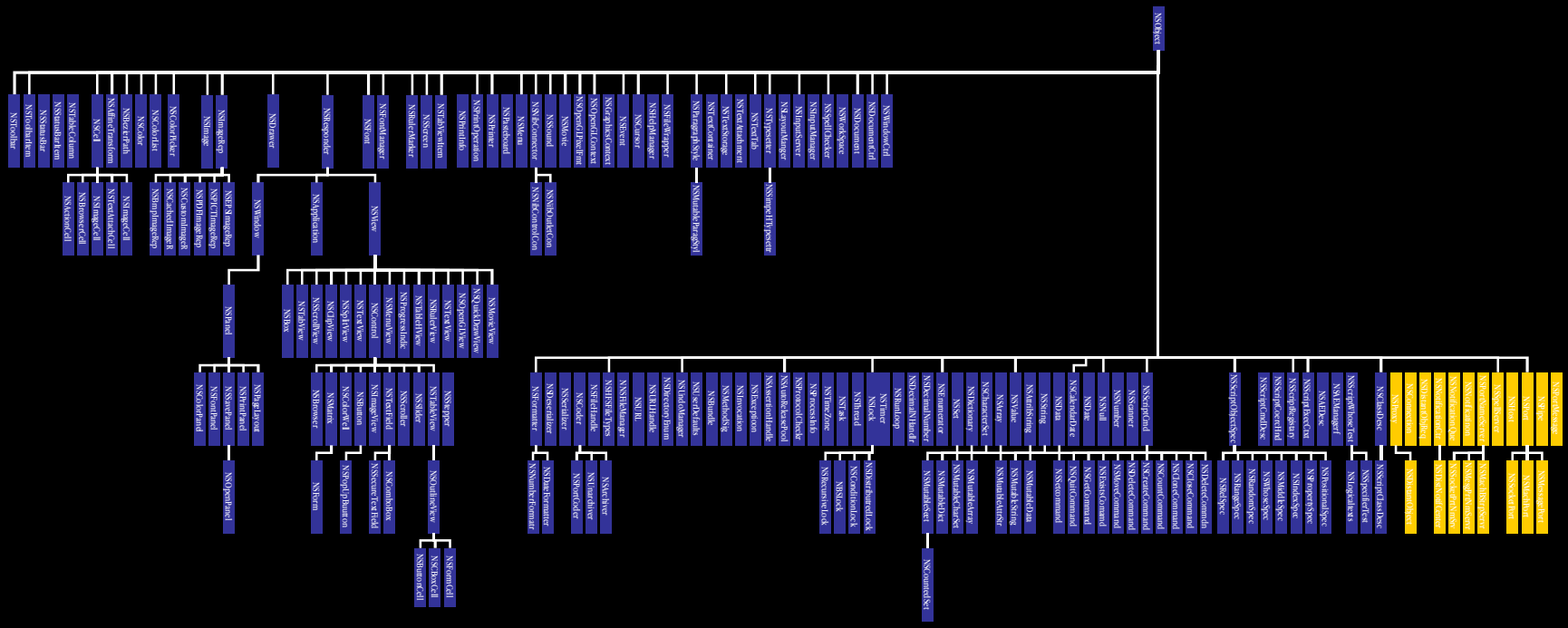
Networking & Communication


NSObject
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NSBezierPath
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NSColorList
NSColorPicker
NSImage
NSImageRep
NSBrowser
NSBrowserCell
NSImageCell
NSFreeformBezierCell
NSImageCell
NSSimpleImageRep
NSCachedImageRep
NSCustomImageRep
NSPDFImageRep
NSEPSImageRep
NSBitmapImageRep
NSImageRep
NSPrinter
NSPrintInfo
NSPrintOperation
NSPasteboard
NSMenu
NSMenuItem
NSMenuItemCell
NSFont
NSFontManager
NSScreen
NSTableSelection
NSPrinterInfo
NSBrowser
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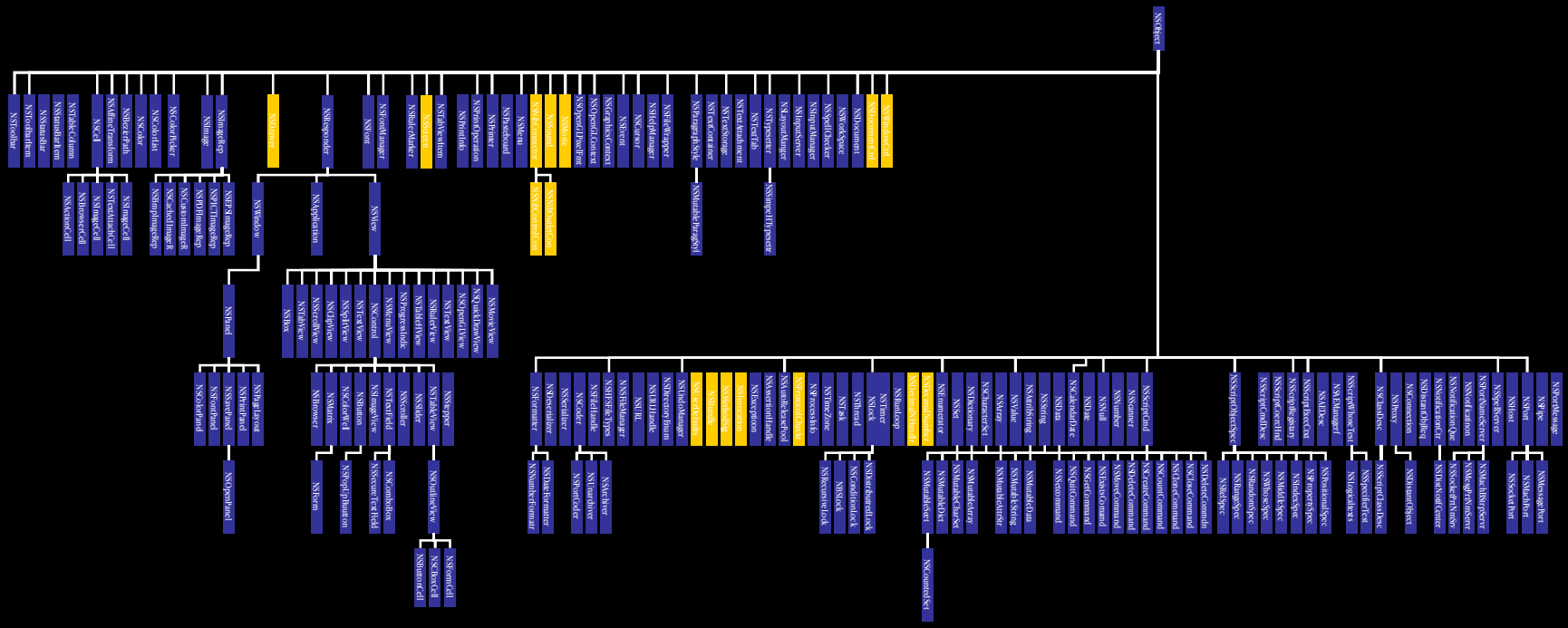
NSBrowserCell
NSBrowserCell

The Others…


NSObject
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NSEPSImageRep
NSPDFImageRep
NSPICTImageRep
NSBrowserCell
NSImageCell
NSTextTableBlock
NSTextCell
NSSimpleImageRep
NSWindow
NSPanel
NSColorPanel
NSFontPanel
NSOpenPanel
NSSavePanel
NSPrintPanel
NSPageLayout
NSApplication
NSResponder
NSView
NSBox
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NSTextView
NSControl
NSMenuView
NSProgressIndicator
NSTitledView
NSBrowser
NSMatrix
NSScrollerCell
NSButtonCell
NSImageCell
NSCell
NSSlider
NSTableView
NSSplitButtonView
NSSegmentCell
NSCheckCell
NSSegmentedCell
NSSlider
NSTextFieldCell
NSTextFieldCell
NSSecureTextField
NSComboBox
NSFont
NSFontManager
NSTextAttachment
NSTextStorage
NSTextContainer
NSLayoutManager
NSGlyphGenerator
NSTypesetter
NSSimpleTypesetter
NSGlyphInfo
NSCharacterSet
NSFontDescriptor
NSMutableFontDescriptor
NSFontPanel
NSFontPanelSharedInstance
NSFontPanelFactory
NSFontPanelFactoryDelegate
NSFontPanelFactoryDelegateProtocol
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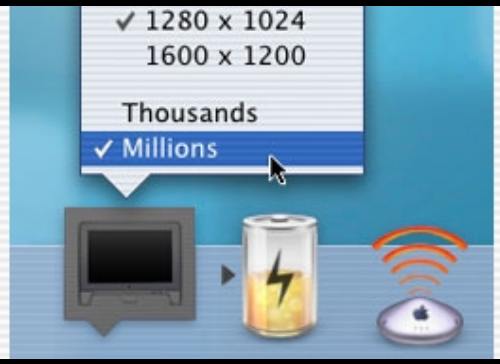
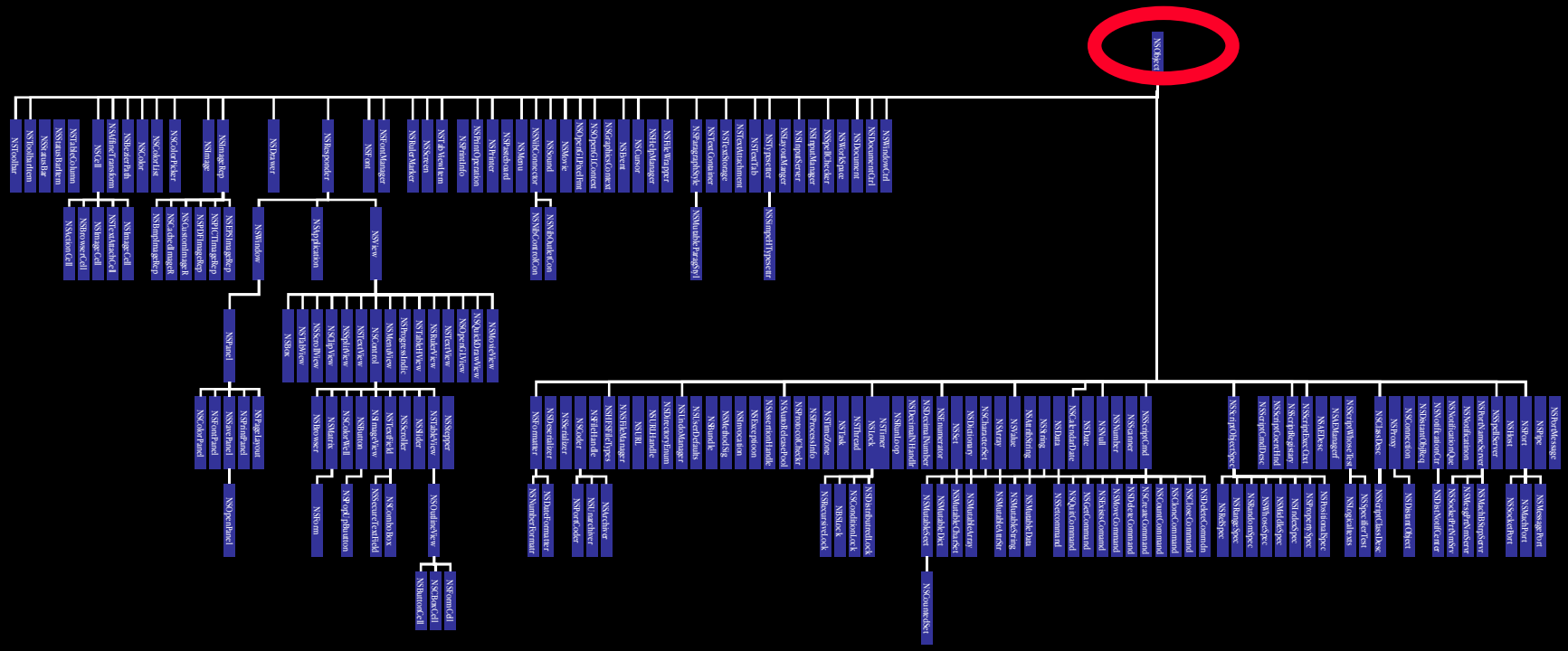
Foundation



The Root—NSObject


NSObject
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NSCell
NSMutableTransform
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NSColorList
NSColorPicker
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NSImageRep
NSBrowser
NSResponder
NSFont
NSFontManager
NSPrintOperation
NSPrintInfo
NSPrinter
NSPasteboard
NSMenu
NSNibConnector
NSSound
NSMovie
NSPortCFPacketPrint
NSOpenGLContext
NSGraphicsContext
NSEvent
NSCursor
NSFileWrapper
NSMenuItemCell
NSImageCell
NSCustomImageRep
NSPDFImageRep
NSEPSImageRep
NSBitmapImageRep
NSNibOutlet
NSNibControlConn
NSNibOutletConn
NSMutableParagraphStyle
NSTextAttachment
NSTextStorage
NSTextContainer
NSTextTab
NSTypesetter
NSLayoutManager
NSTypingServer
NSSpellChecker
NSWorkspace
NSDocumentCtrl
NSWindowCtrl
NSWindow
NSApplication
NSView
NSPanel
NSOpenPanel
NSSavePanel
NSFontPanel
NSPrintPanel
NSPageLayout
NSColorPanel
NSBox
NSClipView
NSScrollVIew
NSTextView
NSControl
NSMenuView
NSProgressIndic
NSTableHeadVIew
NSTableView
NSBrowser
NSMatrix
NSButtonCell
NSButton
NSImageView
NSScroller
NSSlider
NSTableVIew
NSForm
NSApplicationDelegate
NSSecureTextField
NSComboBox
NSOutlineVIew
NSBrowserCell
NSTextCell
NSTableCell
NSFormCell
NSMenuItemCell
NSStepper
NSFormatter
NSNumberFormatter
NSDateFormatter
NSSecretAndLock
NSSpecialLock
NSLock
NSRecursiveLock
NSConditionLock
NSDistributedLock
NSMutableSet
NSCountedSet
NSMutableDict
NSMutableOrdSet
NSMutableArray
NSMutableCharSet
NSMutableString
NSMutableData
NSWriteCommand
NSQuitCommand
NSCreateCommand
NSCountCommand
NSCloseCommand
NSDeleteCommand
NSSetCommand
NSGetCommand
NSMoveCommand
NSExistsCommand
NSIndexSpec
NSRangeSpec
NSUniqueIdSpec
NSWhoseSpec
NSMidDleSpec
NSIndexesSpec
NSPropertySpec
NSRelativeSpec
NSNameSpec
NSIntersectionSpec
NSScriptCmdDesc
NSScriptWhoseTest
NSNegativeTest
NSSpecifierTest
NSLogicalTest
NSScriptClassDesc
NSProxy
NSConnection
NSDistantObject
NSNotificationCtr
NSNotificationQue
NSNotification
NSNetNameServer
NSNetMessagePortNameSer
NSNetMessagePortNameser
NSNetMessagePortNameser
NSNetSocketPortNameser
NSNetSocketPortNameser
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Foundation

- Defines the root of all Cocoa classes: NSObject
- Fundamental classes and support
  - Classes for storage and collections
  - Classes for operating system abstractions
  - Internationalization and localization
- Basic concepts and mechanisms
  - Memory management
  - Mutability

Storage and Collections

- Storage Classes
  - NSValue, NSString, and NSData
- Collection Classes
  - NSArray, NSDictionary, and NSSet
- Can be written to file as property lists

Property Lists

- Ideal as a small, flexible data store
- Used throughout Cocoa and Mac OS X
  - User preferences
  - Configuration files
- Plain text format for simple object graphs
  - Uses industry standard XML
  - Plist DTD is available on the system

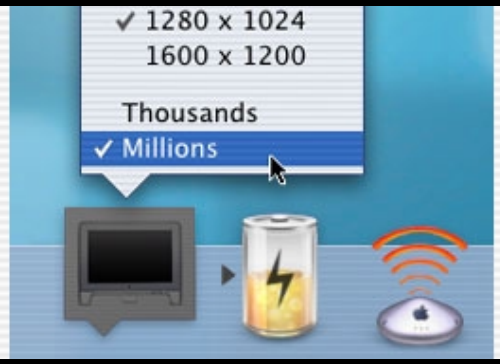
Operating System Abstractions

- OS Mechanisms
  - NSThread, NSLock, NSProcessInfo
- File and I/O
  - NSURL, NSFileHandle, NSHFSFileTypes
- Networking and Communication
  - NSHost, NSPort, NSNotificationCenter
- System Info
  - NSDate, NSTimeZone

Internationalization

- NSString
  - Unicode savvy
  - Supports conversion to and from different encodings
  - Used throughout API in place of (char *)
- NSBundle
  - General resource loading mechanism
  - Load UI, images, strings based on users language preference

Foundation—Concepts



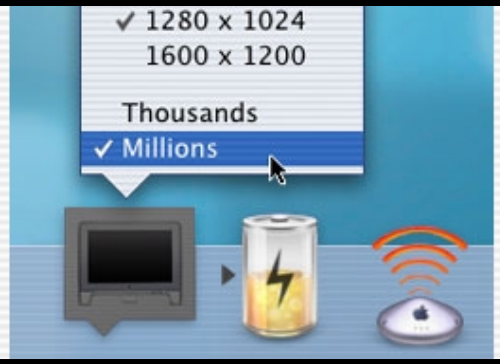
Memory Management

- Cocoa uses reference counting
- Retain adds a reference, release decrements
- The rules are simple
  - By convention only creation methods (alloc, copy, new) return retained objects
  - Retain if you want an object to stay around
  - Release when you are done with an object
  - When there are no references, the object is deallocated

Mutable vs. Immutable

- Why have a distinction?
  - Immutable objects are safe to pass around
  - Immutable classes can use more efficient algorithms
  - . . .but only mutable objects can be modified!!
- Many Foundation objects come in both flavors
  - Storage: NSString, NSMutableString
  - Collections: NSArray, NSMutableArray

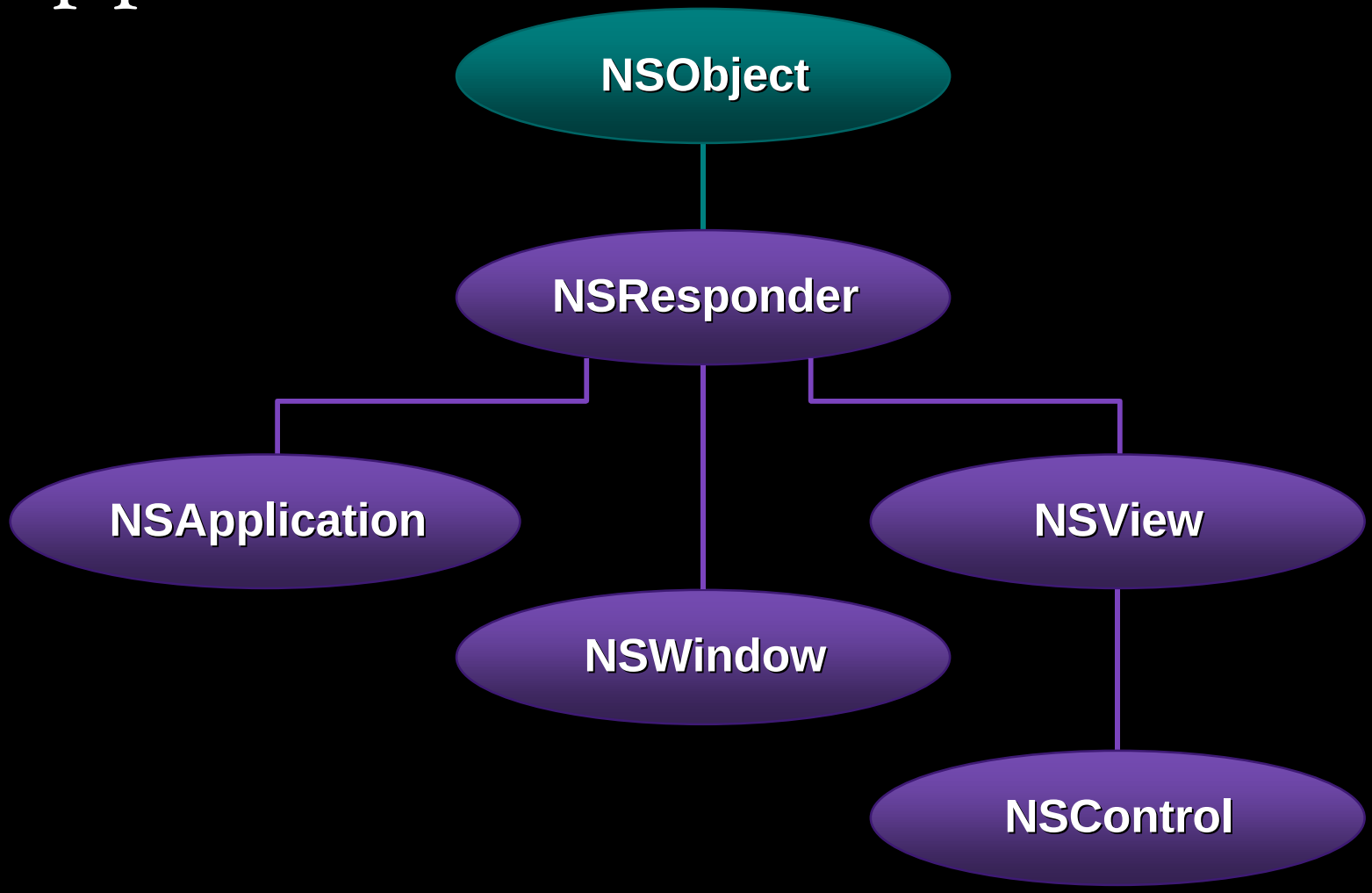
AppKit



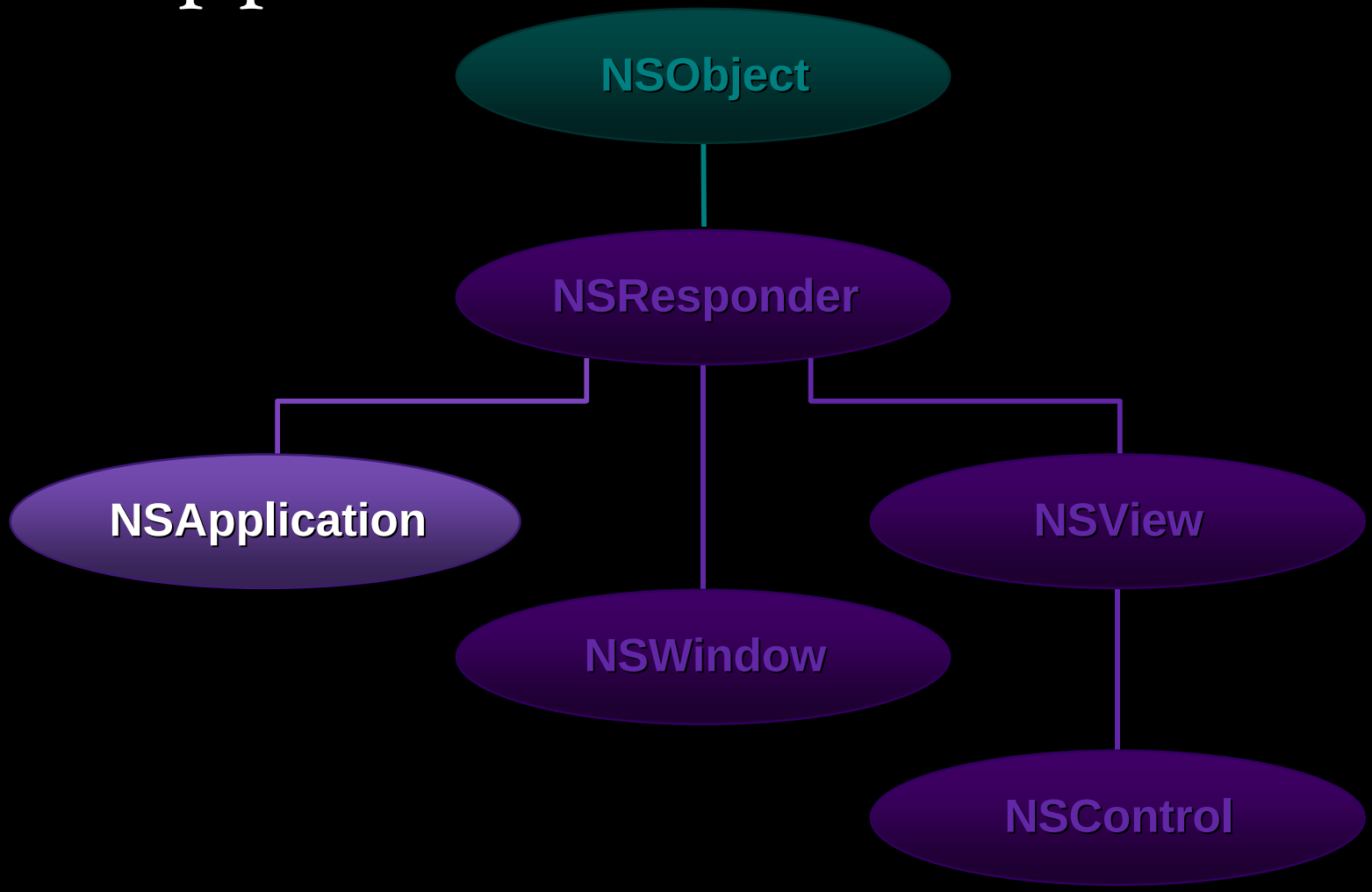
AppKit

- Provides infrastructure for drawing and events
- Provides components needed to build your GUI
  - Basic controls: buttons, checkboxes, sliders
  - Advanced controls: outline view, toolbar
  - Standard dialogs: save, open
  - Other Aqua features: drawers, sheets
- Features a sophisticated text system

AppKit Core Classes



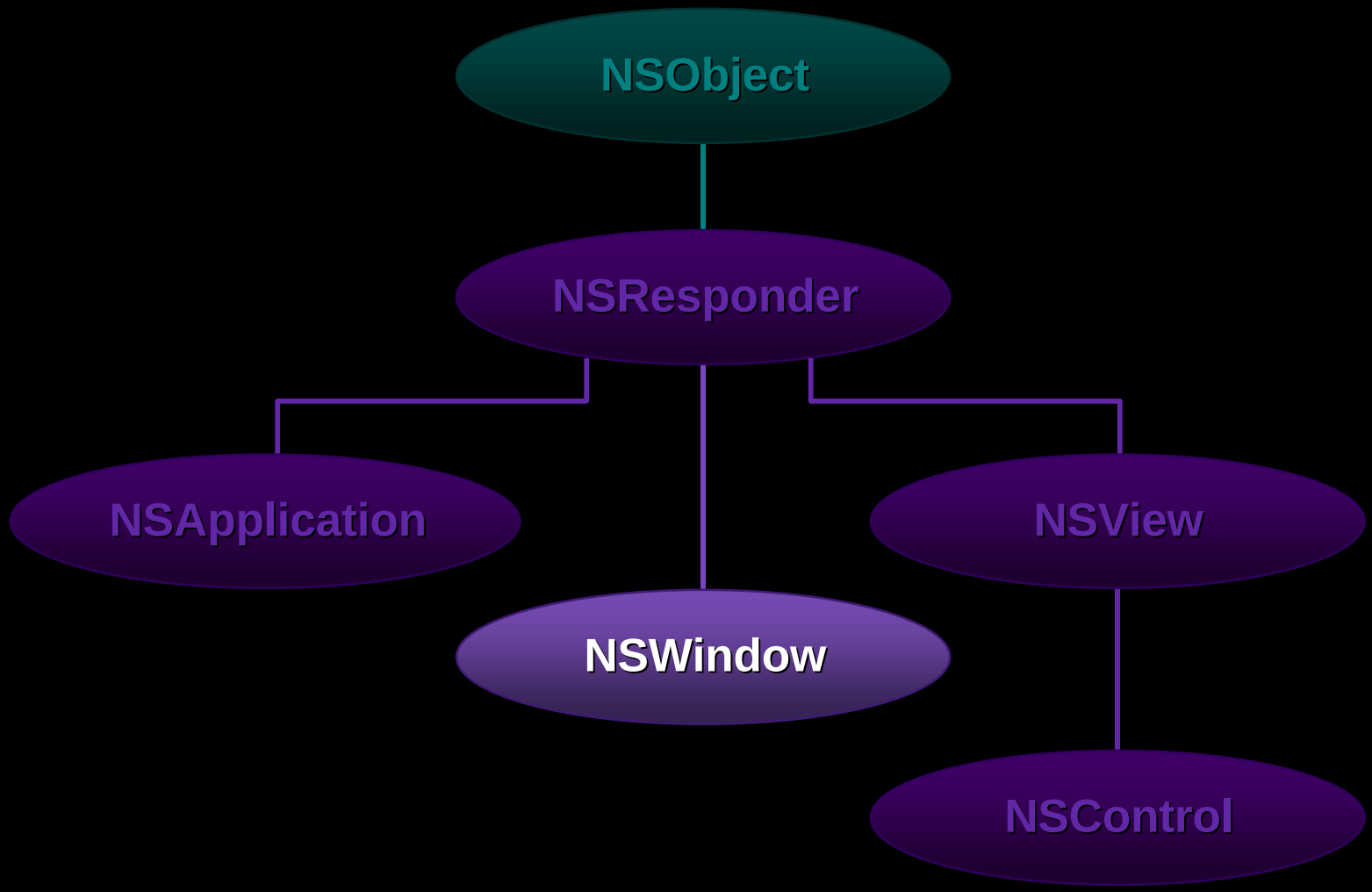
NSApplication



NSApplication

- Every application has exactly one instance
- Manages communication with window server
  - Initializes display environment
  - Maintains list of application windows
  - Receives and dispatches events from the WindowServer
- Provides hooks for typical application events
  - Application termination

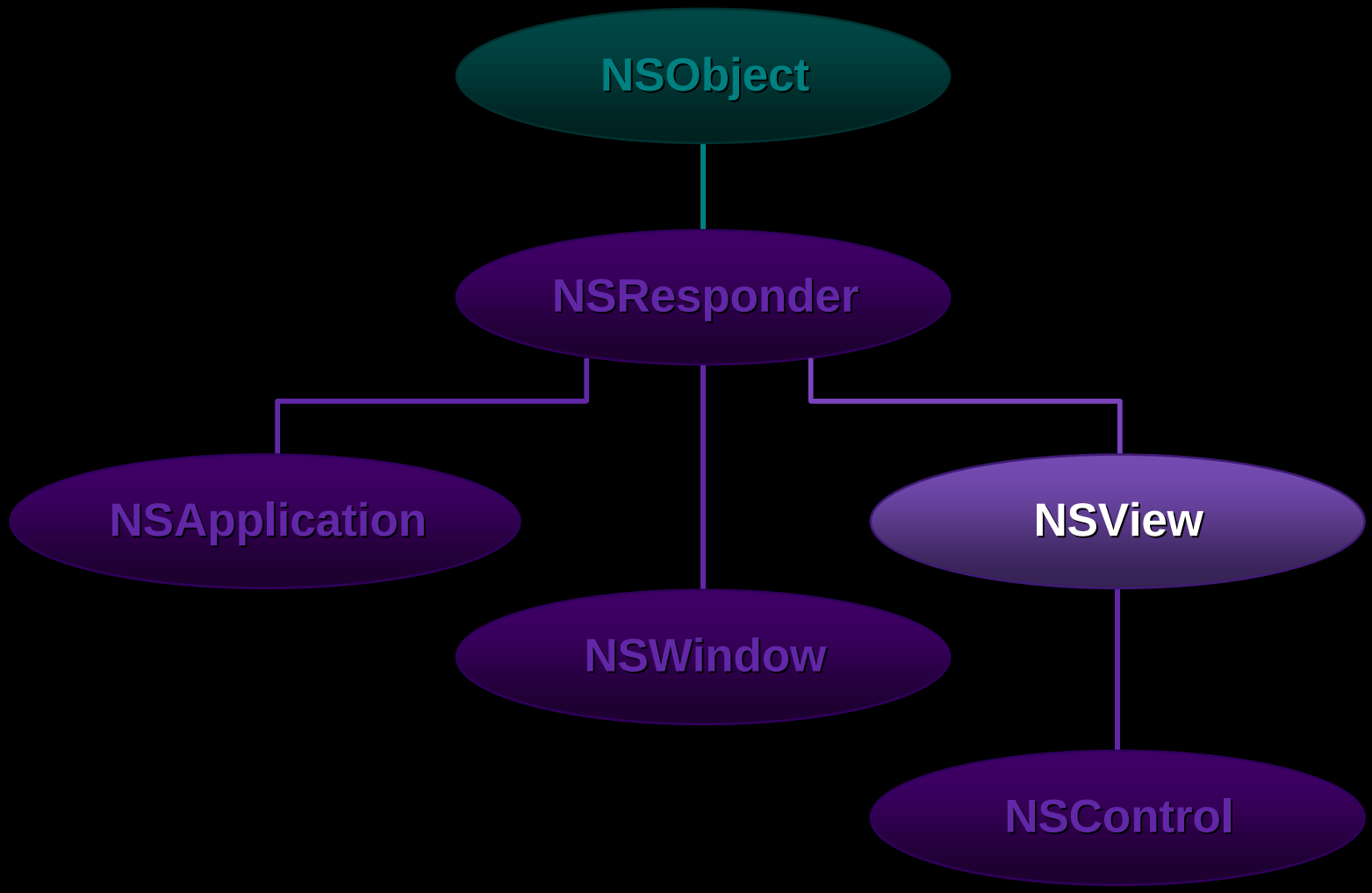
NSWindow


NSObject
NSResponder
NSApplication
NSWindow
NSView
NSControl

NSWindow

- Reserves screen real estate
- Maintains the topmost view in the view hierarchy
- Accepts and distributes events to it's views
  - Clicks go to the view under the mouse
  - Key events go to the current view responding to key events
- Advanced features
  - Drawers and sheets

NSView


NSObject
NSResponder
NSApplication
NSWindow
NSView
NSControl

NSView

- Manages a view hierarchy
  - One superview, many subviews
  - Coordinate system transformations
  - Clipping details
- Provides support for many basic UI notions
  - Drag and drop, context-sensitive menus, help tags

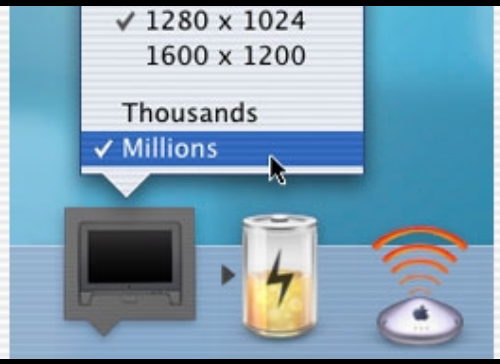
NSView

- Cocoa provides standard views
  - NSTextView, NSMovieView, NSOpenGLView
  - NSTabView, NSScrollView, NSSplitView
- Make your own view by subclassing
  - Override **drawRect()** to customize drawing
  - Override **mouseDown()** to handle mouse events

Drawing

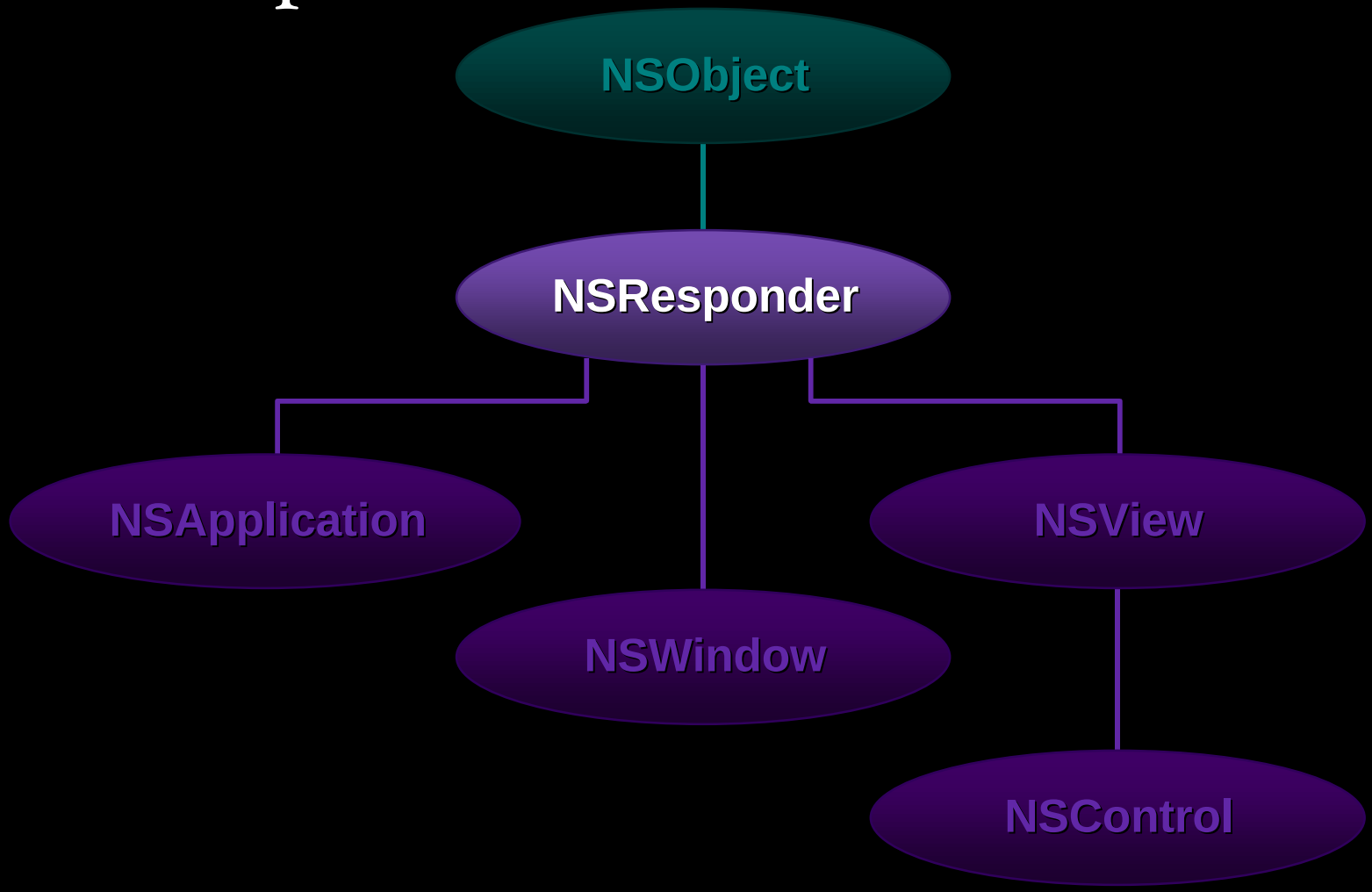
- Cocoa drawing
  - NSBezierPath— **lineToPoint(), curveToPoint()**
  - NSImage— **drawAtPoint()**
  - NSString,NSAttributedString— **drawAtPoint()**
  - NSColor, NSFont— **set()**
  - NSAffineTransform—**set(), concat()**
- Quartz drawing
  - CG Functions can be used

Demo



Douglas Davidson
Cocoa Frameworks

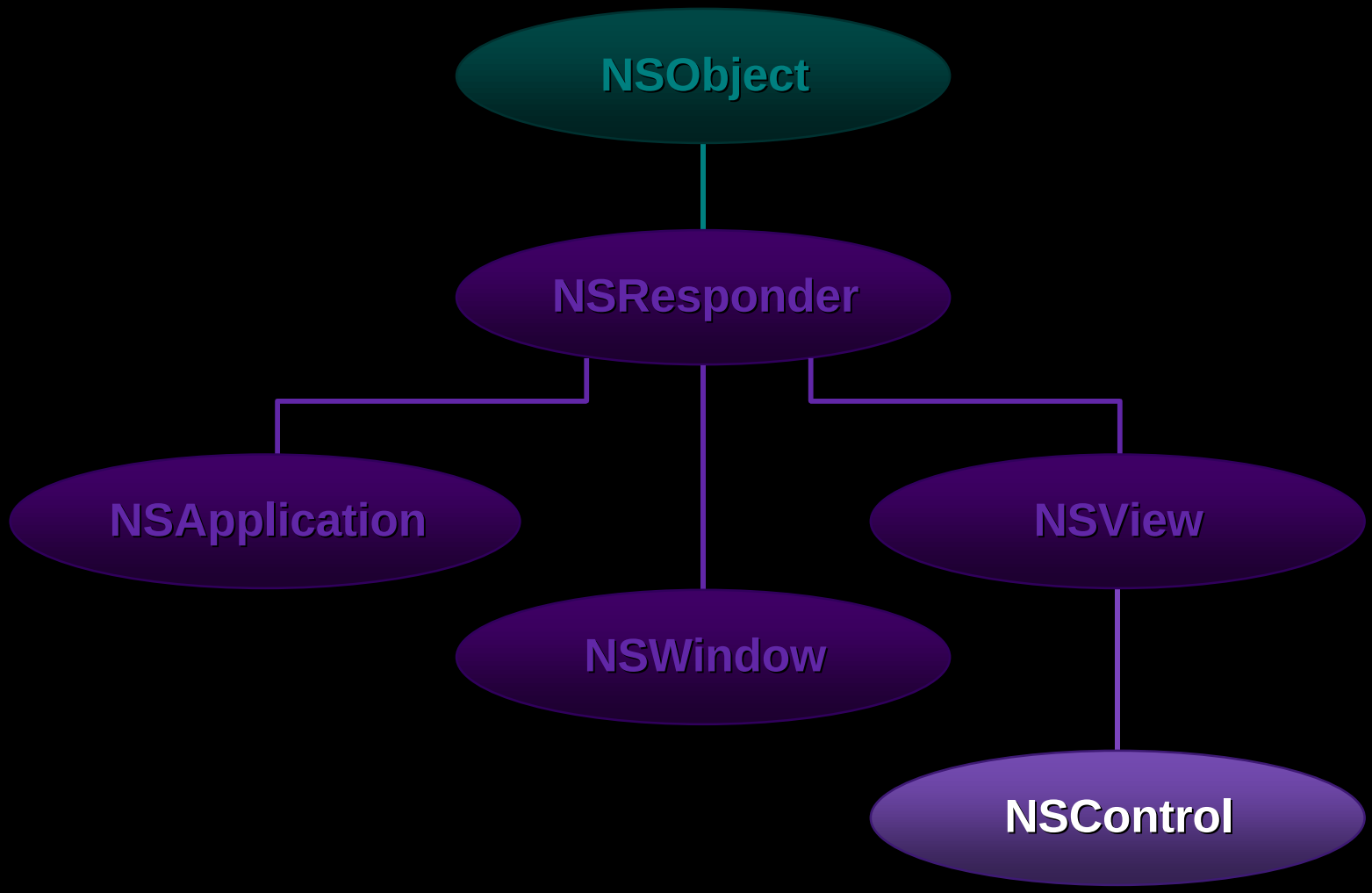
NSResponder



NSResponder

- Any responder can receive events
- Events arrive as methods
  - **keyDown()**
  - **mouseMoved()**
- Events propagate through a responder chain
  - Each NSWindow has a first responder
  - Each NSResponder knows its next responder
  - Events passed down the chain until handled

NSControl


NSObject
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NSView
NSControl

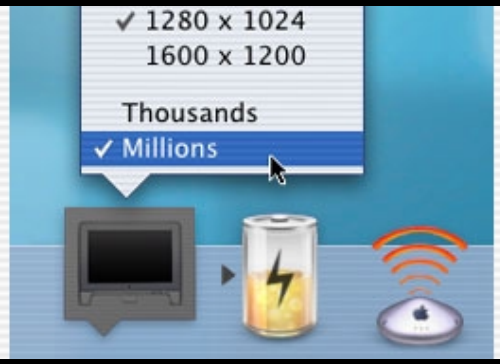
NSControl

- Triggered or activated by user actions
- Examples:
  - Basic: NSButton, NSTextField, NSSlider
  - Advanced: NSOutlineView, NSBrowser
- Have important differences from NSView
  - Have a target object and an action method
  - Have a value that can be queried
  - Can be enabled or disabled

Target/Action

- When a control is “triggered”, it sends the action method to its target object
- Targets can be nil
  - The action method goes to the key window’s first responder
  - Then through the responder chain
- Common first responder methods:
  - **cut(), copy(), undo()**

Demo



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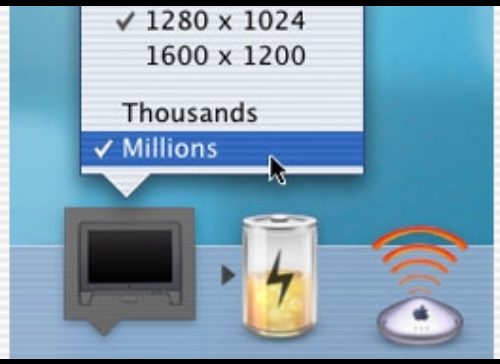
Cocoa Frameworks

Cocoa—Design Patterns



Cocoa—Design Patterns

- Notification
- Delegation
- Model-View-Controller (MVC)

Notifications

- Broadcast happenings throughout an application or even to other applications
- Those interested register as observers
- Examples:
  - NSWindowWillClose
  - NSApplicationWillTerminate
  - NSTextDidBeginEditing
  - NSTableViewSelectionDidChange

The Notification Center

- Rendezvous point for posters and observers
- Observers register with the notification center
  - Provide the notification name, the observed object, and the method to be invoked
- Posters post via the notification center
  - Provide the notification name, and additional information

Delegation

- Allows one object to act on behalf of another
- Provides hooks for you to customize behavior
  - Affect policy— **applicationShouldTerminate()**
  - Perform an action— **applicationOpenFile()**
- Avoids subclassing
  - Lighter weight than creating a subclass
  - Allows several objects to share one delegate

Delegation vs. Notifications

- One delegate per object; maybe many observers
- Delegates allowed to affect behavior
  - Should vs. Will/Did method names
- Example—Making a law
  - House makes a law
  - President may veto: asked “should law pass”
  - Communicated to masses: “law did pass”

Model-View-Controller

- Model stores and performs operations on data
  - Typically more than a simple data store
  - Implements custom domain logic
  - Ignorant of the UI
- View displays with no knowledge of specific data
- Controller acts as mediator between the model and view
- Usually abbreviated MVC

Model-View-Controller

- Example (a grading application)
  - Model—Student information object
  - Views—Table of test scores, graph of scores
  - Controller—Connects the model and views
- Cocoa promotes use of MVC
  - Cocoa's document architecture, text system, and complex controls use MVC
  - Adopting MVC makes scripting and undo easy for you to implement

Cocoa—Application Level Topics

- Document Architecture
- Undo
- Scripting
- Preferences
- Clipboard

Document Architecture

- NSDocument provides common document-based application features
  - Per-document undo stack maintenance
  - Document-edited status management
  - Open dialog and Save sheet presentation
- You subclass for each distinct kind of document
  - Provide a routine to load from an NSData
  - Provide a routine to convert to an NSData

Undo

- Cocoa text system has built-in undo support
- Add your own undo using NSUndoManager
  - When your models data changes, register an undo operation
  - Applied undo actions automatically register redo operations
- Adopting MVC makes undo easy

Scripting

- Cocoa handles events from AppleScript Standard Suite
  - Open, print, quit, …
- Text system provides classes in the Text Suite
- Very little code to add your own scripting
  - Modify a plist
  - Write a method or two
- Adopting MVC makes scripting easy

Preferences

- NSUserDefaults reads and write user preferences
  - Stores per user/application
  - Provides access to system level preferences
- Multiple applications can share preferences
  - Mail and AddressBook share user information

Clipboard

- NSPasteboard transfers data to and from the clipboard
  - Data can be supplied immediately or lazily
  - Filtering convert data to requested format
  - Conversion of standard Mac OS 9 types handled automatically

Summary—Time to Wake Up!!!

- Lots of functionality
- Powerful concepts
- Cocoa gives you a lot for FREE!

Roadmap

122 Using Cocoa: Learn how to use Cocoa APIs to enhance your application through a series of demos	Hall 2 **Thurs., 3:30pm**
123 Advanced Cocoa Topics: Advanced topics such as runloop, IPC, drag and drop, and printing	Hall 2 **Thurs., 5:00pm**
FF112 Feedback Forum: Cocoa Feedback on anything Cocoa	Room A2 **Fri., 5:00pm**

Roadmap

701 Project Builder Introduction: An introduction and overview of the major features in Apples' development environment	Hall 2 **Tues., 2:00pm**
702 Interface Builder: Learn to build Aqua user interfaces	Hall 2 **Tues., 3:30pm**
311 Web-Enabling Your Application: Accessing the web via NSURL, etc…	Civic Auditorium **Thurs., 5:00pm**

Documentation

Information on your CD

- Concepts documents
  - Overview and concepts documentation
  - Class and API references
  - Release notes
- Examples and tutorials
  - AppKit and Foundation examples
- Framework headers

For More Information

- O'Reilly "Learning Cocoa"
- Cocoa Developer Documentation
  http://developer.apple.com/techpubs/macosx/macosx.html
- iServices Technical Training
  http://www.apple.com/iservices/technicaltraining
- Other places
  - **www.stepwise.com**
  - **www.omnigroup.com**
  - **www.cocoadevcentral.com**

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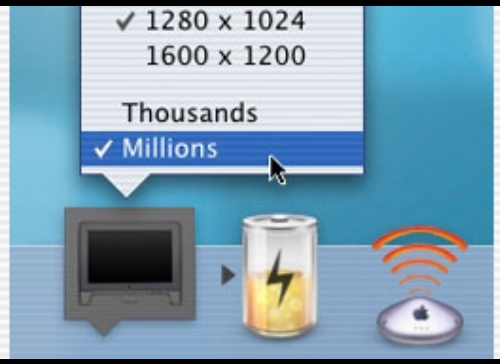

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